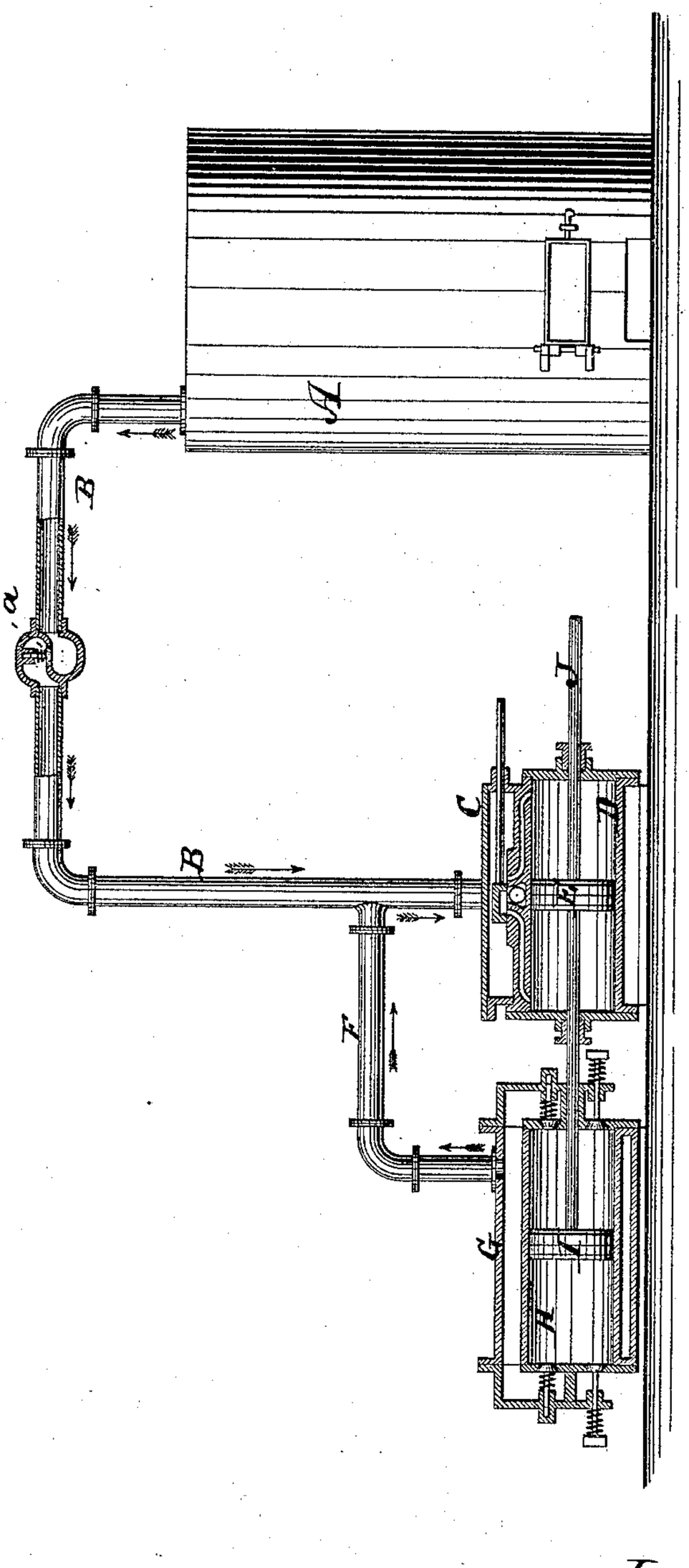
(No Model.)

E. M. STRANGE.

AERO STEAM ENGINE.

No. 328,865. Patented Oct. 20, 1885.



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UNITED STATES PATENT OFFICE.

EDWARD M. STRANGE, OF BROOKLYN, NEW YORK.

AERO-STEAM ENGINE.

SPECIFICATION forming part of Letters Patent No. 328,865, dated October 20, 1885.

Application filed March 5, 1885. Serial No. 157,777. (No model.)

To all whom it may concern:

Be it known that I, EDWARD M. STRANGE, a resident of Brooklyn, in the county of Kings and State of New York, have invented an Improved Aero-Steam Engine, of which the following is a full, clear, and exact description, reference being made to the accompanying drawing, which represents a sectional side view of my improved aero-steam engine.

This invention relates to a certain feature of improvement on the class of combined steam and air engines of which the engine described in Letters Patent No. 252,630, of January 24, 1882, is a type.

The invention consists, principally, in the employment of a certain check-valve in the steam-pipe of the engine, which check-valve is to prevent the passage of air to the boiler, as hereinafter more fully described.

In the drawings, the letter A represents a suitable steam-boiler, which discharges steam, by means of a pipe, B, into the valve-chest C of a steam-cylinder, D, in which cylinder moves a piston, E. The pipe B receives, also, before it enters the valve-chest C, an air-pipe, F, which extends from a chamber, G, that communicates with a cylinder, H, in which moves a piston, I, that is shown to be mounted upon the rod J of the piston E. Whenever the piston E is reciprocated, the piston I will also be reciprocated, and will at each of its strokes force air through the pipe F into the pipe B, so that the chest C will be charged, not with pure steam, but with a mixture of steam and air. Now, in order to prevent the air from being forced through the pipe B into the boiler, I have placed a check-valve, *a*, in the pipe B, said check-valve being so situated that it will be closed whenever the pressure in the pipe B toward the boiler is greater than from the boiler.

The thought has been in the public mind for a long time that the proper mixing of steam and air in the steam-engine cylinder will effect a material saving of fuel in all industries requiring steam-power, and many efforts have been made to utilize this thought. These efforts have heretofore uniformly resulted in the failure to effect a saving of fuel, and one of the chief reasons for the failure seems to be that the air has been permitted to have free access to the steam and water in the boiler.

When air is heated to the temperature of steam as ordinarily used, its capacity for holding water in suspension in the form of vapor is very great, and if it be permitted to have free access to or communication with the steam and water of the boiler, it will drink up or absorb more water than is required to make the volume of steam necessary to enable the engine to do its allotted work.

My invention is an automatic throttle or check valve, placed, as described, in the steam-pipe, permitting the steam to flow from the boiler to the steam-chest of the engine, but preventing the passage of the air from the air-compressor to the boiler. Whenever the air is injected into the steam-pipe B, the pressure of the combined steam and air rises higher than the boiler-pressure, and the valve at *a* closes automatically, thus preventing the passage of the air into the boiler. When the steam-port of the cylinder D is opened, and a sufficient volume of the combined steam and air enters the steam-cylinder to reduce the pressure in the steam-chest below the boiler-pressure, then the valve at *a* opens automatically and permits the needed supply of steam from the boiler to pass it and effect an equilibrium of pressure between the boiler and the steam-spaces from *a* toward the steam and compressing cylinders.

Moreover, considerable saving of fuel will be realized from the fact that by the weight of the valve *a*, which may be supplemented by a suitable spring, if desired, and also by the differences in area, it will require more pressure to open the valve than it does to shut it; hence, when the valve is closed, the combined steam and air which is contained in the pipe B between the valve *a* and the steam-chest C will remain operative until its pressure becomes so much below that of the steam in the boiler as to cause the valve to be again opened, and this period of operativeness while the valve is closed will relieve the boiler of what otherwise would be unnecessary waste.

I claim—

The combination of the steam-boiler A and its pipe B, steam-chest C, steam-cylinder D, air-cylinder H, and air-pipe F, with the check-valve *a*, placed in the pipe B between the air-pipe F and the boiler A, substantially as herein shown and described.

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